

Claims

- [c1] An illuminating device providing controlled illumination comprising:
- a) a plurality of independent light sources, each said independent light source emanates light having a spatial light intensity distribution characteristic and each said independent light source emanates light having spectral wavelength characteristics,
 - b) a structure having predetermined form and orientation where said orientation is correlated to the environment to be illuminated and,
 - c) said independent light sources attached to said structure such that said spatial light intensity distribution has a directionality respective to said orientation and,
 - d) said directionality effects the mixing, adding and distribution of emanating light such that said controlled illumination is a product of said independent light sources,
- whereby a new, more useful illuminating characteristic differing in its intensity, intensity spatial distribution and spectral composition has been created.

- [c2] The illuminating device of claim 1 is an application

oriented luminaire designed according to correct lighting practice, providing said controlled illumination in the correct light intensity, spectrum, and spatial distribution of intensity and spectrum, suited to the specific lighting application, comprising a plurality of individual light sources capable, in combination, of providing the correct intensity, spectrum, and spatial distribution of intensity and spectrum.

- [c3] The illuminating device of claim 1 wherein the correct light intensity, spectrum, and spatial distribution of intensity and spectrum is adjusted for changes in the lighting application environment comprising a means for changing the light emanating characteristics of individual light sources capable, in combination, of providing the correct intensity, spectrum, and spatial distribution of intensity and spectrum as a function of time.
- [c4] The illuminating device of claim 1, wherein the illuminating device is a luminaire providing controlled illumination comprising: a) plurality of independent light sources, each said independent light source having said characteristics, b) a structure having predetermined form and preferred orientation where said preferred orientation is correlated to the environment to be illuminated and c) said independent

light sources attached to said structure such that the spatial light intensity distribution of said independent light sources is having a directionality to said structure and position on said geometric support structure of said light sources having known light intensity and spectral characteristics, and d) where said spatial light intensity distribution characteristic, spectral wavelength characteristic, position and directionality is individually determined by using equations to calculate the required light source properties according to one or more of the lighting application requirements, including illuminance, color temperature and color rendering over the area and one or more of the luminaire design criterion where the criterion include luminous intensity, spectral wavelength distribution, the requirement of maintaining an acceptable continuum of spatial illumination and color effects and the requirement of maintaining an acceptable glare rating for the luminaire and e) where the support structure has a considered geometry determined by the requirement of supporting the said independent light sources at the proper aimings and positions on the surface and f) where size, shape and coloring of the geometric support structure is also function of one or more considerations including containing the light sources, the ancillary equipment

and aesthetic considerations.

- [c5] The illuminating device of claim 1, further comprising elements selected from the group consisting of:
a) a power supply element providing current at a voltage to the light sources and other ancillary equipment; and, b) a differentiated power supply element capable of varying power to said independent light sources having means to effect the sending or not sending an independent electric power signal differentiated in voltage, current or frequency to each light source or group of light sources; and, c) a controller for adjusting the power to the light sources to such that a particular amount of power supplied to the light source generates a corresponding intensity and provide the correct intensity, spectrum, and spatial distribution of intensity and spectrum for the application; and, d) a storage media device capable of storing and recalling stored data relating to performance, algorithms, lighting parameters and, e) a controller capable of receiving inputs and by means of recalling stored parameters, processing algorithms, and calculating results, generates output control signals to adjust the illumination according to correct lighting practice; and, f) a photosensor for providing light spectrum and intensity information to

the controller, said information for use in said adjusting; and, g) a motion detector for providing occupant sensing information to the controller, said information for use in said adjusting; and, h) a communications element coupled to the controller comprised of a receiver for receiving a data signal from an external device, and,i) a communications element coupled to the controller comprised of a transmitter for transmitting a data signal to an external device, and, j) a remote control man-machine interface input device capable of communicating data with the communications element; and, k) a machine vision system comprised of an imaging device, object recognition and, l) optical elements situated proximate to each individual light source, groupings of light source or all the light sources to control the direction of the emanating light, where the term optical refers methodologies used for redirecting light rays through any of the known phenomenon including: reflection, refraction and diffraction, m) a mechanical assembly for the support of light sources, power supplies, controllers, sensors and other ancillary equipment and, o) a satellite reflector receiving light from the luminaire and redirecting said light to illuminate a distant area.

- [c6] The illuminating device of claim 1, wherein said controller is selected from the list consisting of, a) an open-loop controller, factory programmed, for use in general lighting according to correct lighting practice: and, b) an open-loop controller, user-programmed, by use of a programming method taking into account the lighting requirements of the environment in which the luminaire is to be used: and; c) a closed loop controller, user-programmed, by use of a programming method taking into account the lighting requirements of the environment in which the luminaire is to be used; and, d) a closed loop controller user-programmed, by use of a programming method taking into account the lighting requirements of the environment and self-adjusting in response to the changing lighting requirements of the environment in which the luminaire is located: and, e) a closed loop controller, self-adjusting in response to the lighting requirements of the environment in which the luminaire is located, without pre-programming.
- [c7] A luminaire comprising: a) light sources potentially having intensity and spectrum characteristic change over life of said light sources; and, b) self-calibration correcting for said aging of said light sources.

- [c8] The luminaire of claim 7, wherein said self-calibration comprises: a) a photodetector for measuring light output of light sources; and, b) reference light sources not having said aging, for providing reference light output to the photodetectors, for use in said self-calibration; and, c) a reference reflective surface of having known reflectance properties for use in said self-calibration.
- [c9] The luminaire of claim 8, wherein said reference light sources are selected from the list consisting of: a) reference light sources similar to the light sources used for illumination, the reference light sources not used for illumination, hence not having aging; and, b) reference light sources not similar to the light sources used for illumination, said not similar light sources selected from the list consisting of 1) daylight; and, 2) white LEDs.
- [c10] The luminaire of claim 6, wherein said self-adjusting is performed in a short time interval, such that the self-adjusting is not noticeable to an observer; and, such that adjacent luminaires do not interact, due to low probability of two luminaires self-adjusting simultaneously; and, extremely low probability of two

adjacent luminaires self-adjusting repeatedly simultaneously; due to random timing variations of the timing circuitry which initiates the self-adjusting interval in each luminaire.

- [c11] A method for designing an application oriented luminaire comprising the steps of:
 - a) determining the application and illuminance requirements
 - b) determining the illumination area or field of view to be covered
 - c) determining the light source aimings which meet the said illuminance requirements.
- [c12] The method for designing an application oriented luminaire of claim 11, designed according to correct lighting practice, providing the correct light intensity, spectrum, and spatial distribution of intensity and spectrum, suited to the specific lighting application, comprising the steps of: a) determining the lighting application, and the recommended lighting practices for the application b) determining the luminaire mounting height, illumination area covered and surrounding conditions typical of the application c) determining light power required to effect the required illumination over the area d) selecting SLS types capable of producing required intensities and spectrum at

highest conversion efficiencies at lowest economic cost e)determining SLS beam spreads f)determining SLS aimings for the required distribution pattern g)determining electronics to control and power SLS h)determining lighting fixture surface geometry and size i)testing whether the glare rating for the viewing angle is acceptable j)if the glare rating is not acceptable, then changing SLS beam spread, fixture geometries, or size, resulting in an acceptable glare rating; and, h)when the glare rating is acceptable, then designing the luminaire aesthetics for the application.

- [c13] The method of selling an application oriented luminaire comprising: a) Having the customer know information about the illumination area to be covered and application of illumination to be provided, b) providing luminaire information in terms of illuminance values specifying and selling the luminaire by area covered by the illumination provided, hence by the "coverage area", concept, not by the prior art light bulb, watts and lumens concept.
- [c14] The illuminating device of claim 1, further comprising: a) light sources mounted on a substrate, b) conductors are disposed on said substrate and c) a plurality light source elements are attached to said substrate and connected to said conductors to receive

power signals and d) where said light emitting elements being formed of non-packaged semiconductor junctions and , e) said light emitting elements are mounted on a support structure having a geometry and, f) where said support structure has means for transferring heat and g) where the said light emitting elements are of directional orientation mounting providing the proper ratios of spectral wavelengths and illumination.

- [c15] The illuminating device of claim 2 wherein the lighting application is a street light having differentiated spectral wavelength output over the spatial distribution.
- [c16] The illuminating device of claim 15 wherein the lighting application is a street light having differentiated spectral wavelength output over the spatial distribution and varying intensity over time in relation to changing environmental conditions including traffic conditions.
- [c17] The illumination device of claim 2, wherein the lighting application is a automotive headlamp having differentiated intensity spectral wavelength output over the spatial distribution which is varies according to the environmental conditions including one or more

factors such as speed, oncoming traffic and dynamic road requirements.

- [c18] The illumination device of claim 17 wherein the control system to dynamically vary the illumination receives inputs from a machine vision system with means for imaging and object recognition.
- [c19] The illumination device of claim 2 wherein the luminaire has means of providing both "background" room lighting, and "task" lighting, and said spatial distribution of spectrum and intensity, further including positional dependence of spectrum vs. intensity and a specified design range of spectrum vs. intensity.